Fisheries biology and population dynamics of the pale octopus (*Octopus pallidus*)

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Photo: J.P.Keane III

Frontispiece: *Octopus pallidus*

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Abstract

Although global octopus catches are increasing, the lack of a direct ageing technique has resulted in the use of inappropriate or non-validated growth and longevity determination methods for octopus fisheries assessments. This has limited our understanding of the inter-relationships between age, growth, reproductive investment and recruitment, potentially jeopardising the ecologically sustainable development of octopus fisheries. The present study is the first to determine the age composition of a wild octopus population by quantifying validated growth rings within stylets (vestigial shells), and examine the effect of both temperature and hatchling size on captive juvenile growth using simulated seasonal temperature regimes. This information was combined with reproductive biology and fishery data, to determine the life history characteristics and dynamics of a wild octopus population.

The focus of this study was the holobenthic species *Octopus pallidus* and its expanding fishery in south-east Australian waters. The results demonstrated that the typical life span of *O. pallidus* is 12 months, with a maximum age of approximately 18 months. Strong individual growth heterogeneity, ranging from 1.32 – 6.9% body weight per day, resulted in age having no distinguishable relationship with either size or reproductive development. Maturation was proven to be primarily a size driven process that varied between genders, with females reaching 50% maturity at 473 g and all males

sampled mature at 250 g, which was the minimum capture size for both genders. At the population level there appeared to be some reproductive synchronicity, with a peak spawning period during late summer – early autumn. This may be an 'optimal' spawning period as captive juvenile growth trials determined that octopus hatched during summer will grow faster and ultimately larger than those hatched during spring. Juvenile growth was also shown to have a positive relationship with initial size and food consumption in the spring/summer (14 – 18° C) treatment. However, in the summer/autumn (18 – 14° C) treatment, high temperatures at hatching caused a spike in growth, particularly for initially smaller octopus. The catch per unit of effort (CPUE) in the commercial fishery was heavily influenced by seasons, with strong annual fluctuations in female CPUE that peaked every two years during summer/autumn. Consistent fishing pressure on a fixed position research area led to a progressive reduction in female fecundity, which would eventually impact upon recruitment. This was not identified in catch rates, suggesting that repeated fishing pressure on localised stocks of a holobenthic octopus species could lead to size selective fishing mortality and localised depletion, which would not be detected by the analysis of fishery data.

By combining age-specific life history and population dynamics information with detailed analysis of fishery data, this study provides and in-depth and integrated assessment of the biology, ecology and fisheries dynamics of a wild population.

Statement of co-authorship

Chapters 2–5: Were prepared as scientific manuscripts as identified on the first page of each chapter. In all instances the candidate had the primary responsibility, however, the supervisors contributed to the experimental design and implementation of the research program, data analysis, interpretation of results and manuscript preparation. The contribution of each co-author was as follows:

Chapters 2, 3 and 4: Dr Jayson Semmens and Dr Gretta Pecl of the Tasmanian Aquaculture and Fisheries Institute (TAFI) were supervisors for this Ph.D. project. They contributed to the experimental design and data analysis, manuscript preparation and animal husbandry.

Chapter 5: Dr Philippe Ziegler (TAFI) provided advice on statistical analysis, demonstrated how to run the appropriate statistical computer packages and contributed to manuscript preparation. Dr Jayson Semmens (TAFI) edited the manuscript and provided directional advice.

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